

CONTINUOUS FIBER CERAMIC COMPOSITES

Project Fact Sheet



CFCC REFINERY PIPE HANGERS

BENEFITS

Industries that use CFCC components in their applications will realize substantial energy, environmental and financial benefits, including higher efficiency, lower maintenance, and decreased operating costs. Benefits will accrue from optimization of process operating conditions, reduced down time, and increased useful life times. Replacing metal refinery pipe hangers with CFCC pipe hangers will provide:

- lower deformation at process temperatures
- increased resistance to oxidation and corrosion
- increased resistance to creep and fatigue
- potential for substantial reduction of downtime and maintenance
- increased plant safety due to decreased weight and the elimination of catastrophic failures

APPLICATIONS

CFCC components are candidates to replace high alloy steel pipe hangers supporting an array of pipes in petrochemical plants and petroleum refineries.



POLYMER IMPREGNATION AND PYROLYSIS (PIP) PROCESS USED TO FABRICATE CFCC PIPE HANGERS FOR REFINERIES

The U.S. Department of Energy's Office of Industrial Technologies (OIT) initiated the Continuous Fiber Ceramic Composite (CFCC) Program in 1992 as a collaborative effort between industry, National Laboratories, universities and government.

Through support of the CFCC Program, Dow Corning Corporation has developed a versatile polymer impregnation and pyrolysis (PIP) process to fabricate complex-shaped ceramic composites. The PIP process offers significant flexibility in comparison to other ceramic composite fabrication processes. It uses low-temperature forming and molding steps typically used in the fabrication of polymer matrix composites.

Dow Corning is designing and fabricating CFCC tube hangers to replace the heavy steel hangers used in petroleum refining. An early step in petroleum refining is to heat crude oil to $>1,500^{\circ}\text{F}$. This is done by flowing the oil through long horizontal metallic tubes in a large natural gas heated furnace. The tubes are supported at intervals by stainless steel hangers. The steel hangers (30 lbs) are heavy and tend to fail, however, CFCC hangers (3 lbs) offer the same support at much less weight. The pipe hangers operate at temperatures to $2,000^{\circ}\text{F}$ and must survive the standard operating period of three years between maintenance operations. The operating temperature is close to the limit for alloy steel performance, but CFCC hangers can provide an insurance level of at least 300°F . Due to the failure mechanism of CFCC's, a damaged hanger could be detected before catastrophic failure.

REFINERY PIPE HANGERS



CFCC tube hangers (shown above - 18 and 39 inches long) can support refinery pipes exposed to temperatures up to $2,200^{\circ}\text{F}$.

Project Description

Goal: The goals of this project are to: 1) optimize the long-term, high temperature durability of CFCC materials for application in refinery furnaces; and 2) utilize cost-effective raw materials and processing.

As exhibited by this project, the CFCC Program is addressing the critical need for advanced materials that are lighter, stronger, and more corrosion-resistant than metals. The Program strives to advance processing methods for reliable and cost-effective ceramic composite materials to a point at which industry assumes the full risk of development and commercialization. The long-term strategy is to develop the primary processing methods for reliable and cost-effective fabrication of CFCCs and to perform application-specific testing which will meet the needs of a wide range of energy saving applications in industry. These industries include: power generation, agriculture, aluminum, steel, chemicals, forest products, glass, metal casting, mining and refining.

Progress and Milestones

- Developed a process to fabricate CFCC pipe hangers by conventional layup of a flat panel using woven fabric prepegged with a preceramic polymer. Following curing and several impregnation/pyrolysis cycles, the hanger shape was formed by cutting with a CO₂ laser. The PIP process was then completed by a sequence of polymer impregnations and firings to convert the polymer to ceramic.
- Produced prototype tube hangers up to 36 inches in length for use in the refining industry. A CFCC hanger weighs just three pounds, while the current metallic hanger weighs thirty pounds.
- Conducted coupon tests to evaluate long-term effects of exposure of CFCC materials at temperatures to 2,000° F in a refinery crude furnace unit. Tests of 4,400 and 8,500 hours in duration demonstrated acceptable durability of the CFCC materials.
- Dow Corning and a petroleum refiner will partner to field test CFCC pipe hangers.



PROJECT PARTNERS

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